Using the Frames Subsystem

January 2009

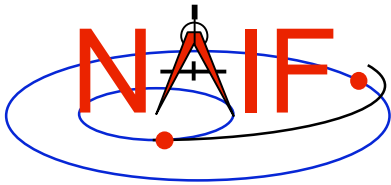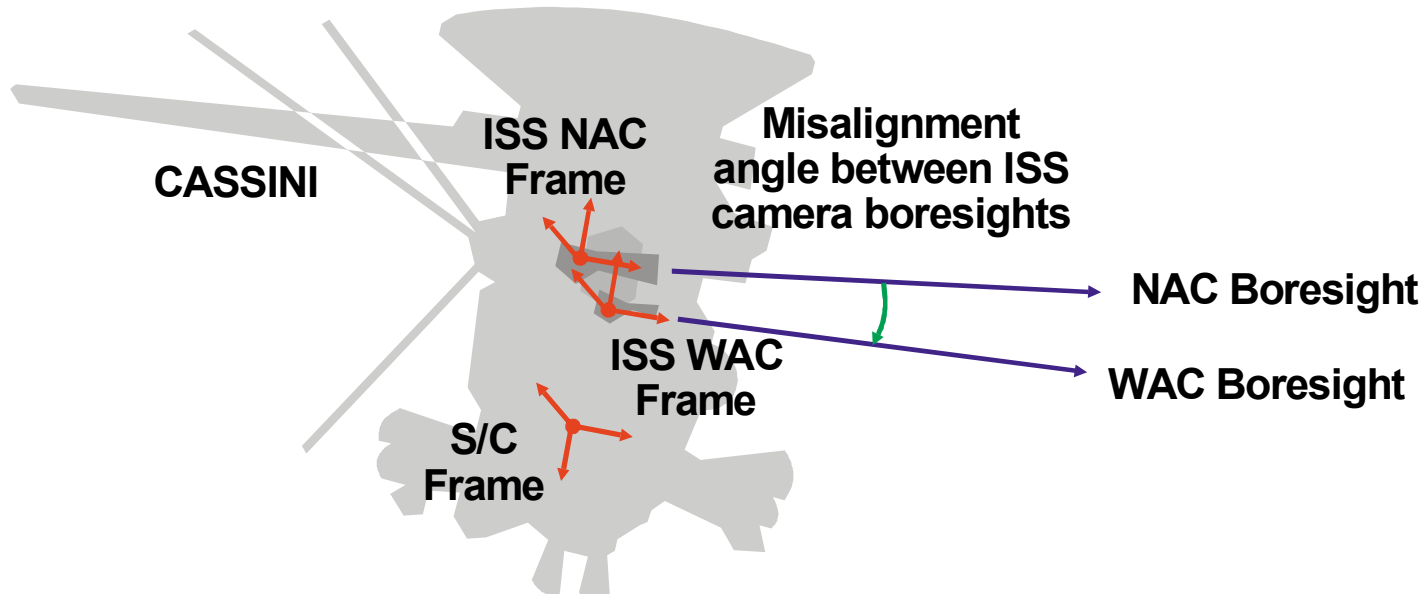**Navigation and Ancillary Information Facility**

- The "power" of the Frames capability stems from the SPICE system's ability to construct complex reference frame transformations with no programming effort required of you - the end user
  - But your selecting and loading the needed kernels is crucial

- The principal benefit from the Frames capability is obtained through the main SPK subsystem interfaces (SPKEZR and SPKPOS) and the Frames subsystem interfaces (SXFORM and PXFORM)

- The remaining pages illustrate typical use of frames

- Several VERY IMPORTANT usage issues are mentioned in the core Frames tutorial (fk.∗); be sure to also read that.

In SPICE terminology: "reference frame" ≠ "coordinate system"

CASSINI

ISS NAC Frame

Misalignment angle between ISS camera boresights

NAC Boresight

ISS WAC Frame

WAC Boresight

S/C Frame

Compute the angular separation between the ISS Narrow Angle Camera and Wide Angle Camera boresights:
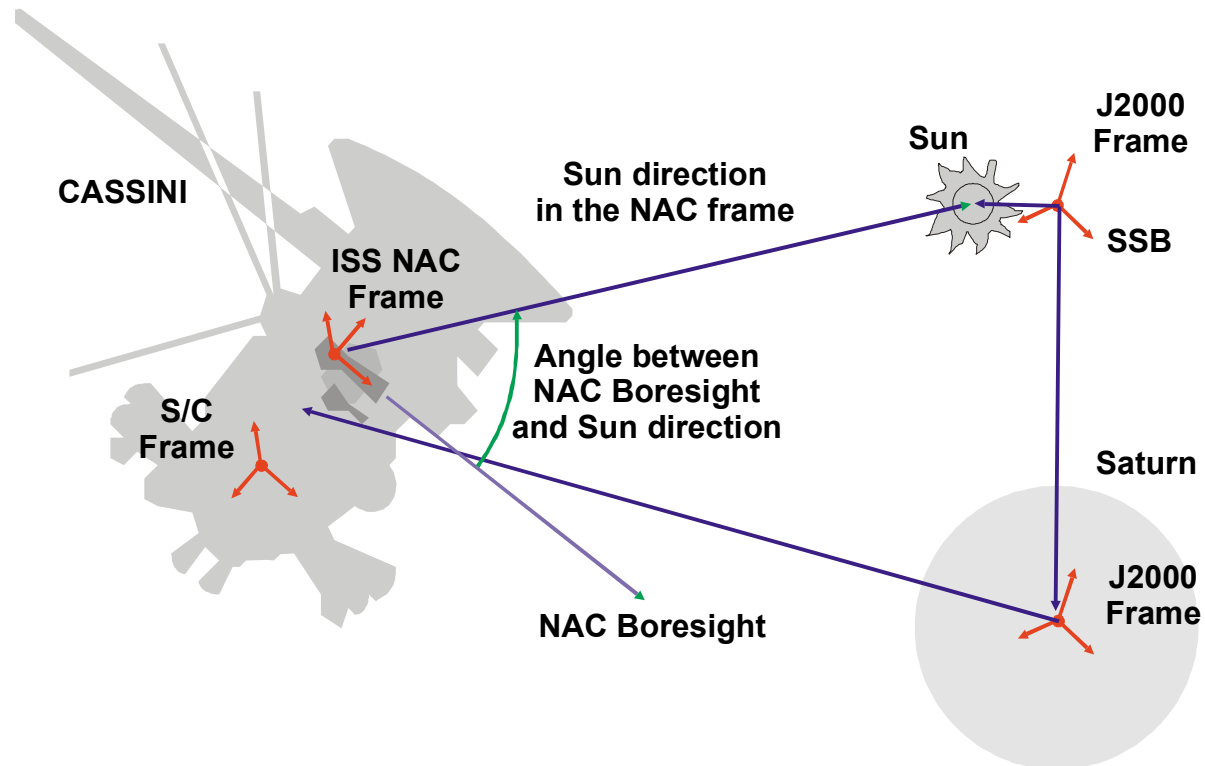
```
C       Retrieve the matrix that transforms vectors from NAC to WAC frame
        CALL PXFORM( 'CASSINI_ISS_NAC', 'CASSINI_ISS_WAC', ET, MAT )
C       Transform NAC boresight to WAC frame and find separation angle
        CALL MXV ( MAT, NAC_BORESIGHT_nac, NAC_BORESIGHT_wac )
        ANGLE = VSEP( NAC_BORESIGHT_wac , WAC_BORESIGHT_wac )
```
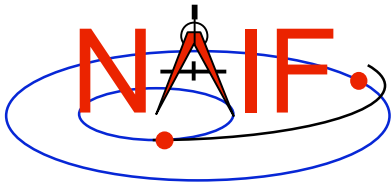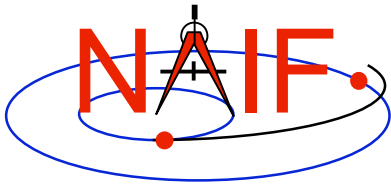
Using Frames

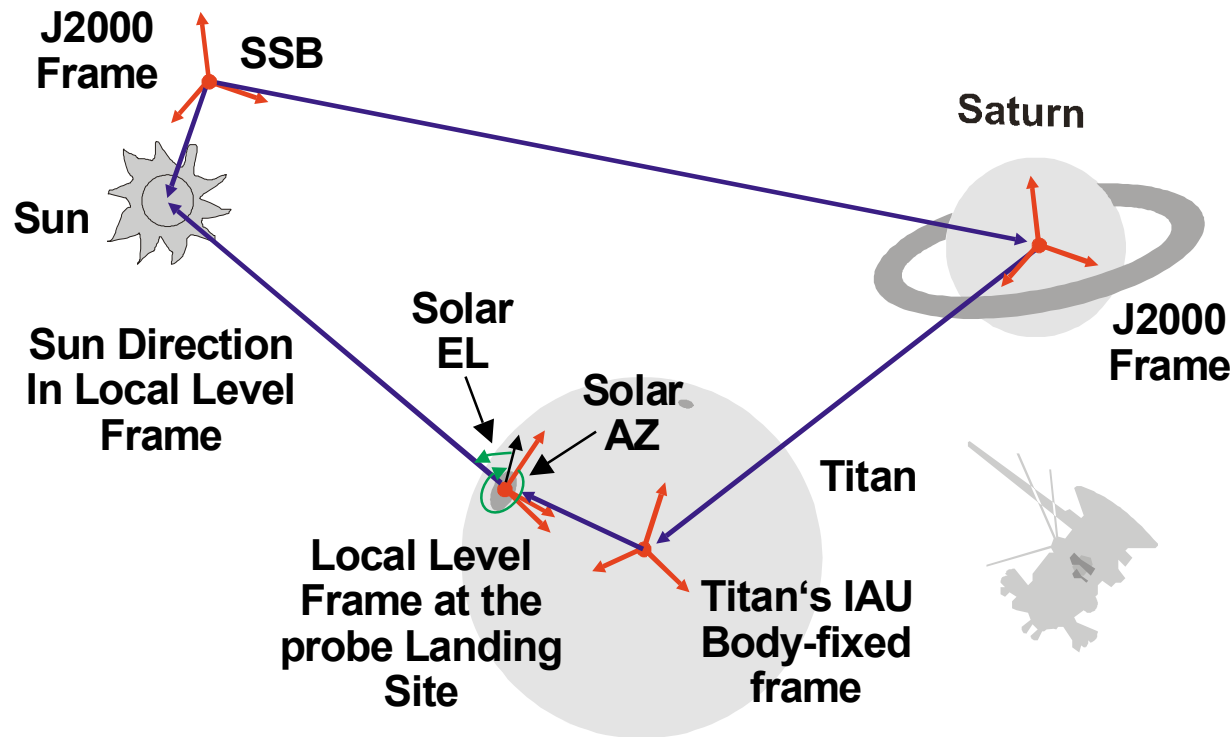**Navigation and Ancillary Information Facility**

Check whether the angle between camera boresight and direction to Sun is within allowed range:

```
CALL SPKPOS( 'SUN', ET, 'CASSINI_ISS_NAC', 'LT+S', 'CASSINI', SUNVEC, LT )
ANGLE = VSEP( NAC_BORESIGHT_nac, SUNVEC )
IF ( ANGLE .LE. CONSTRAINT ) WRITE(*,*) 'WE ARE IN TROUBLE!'
```
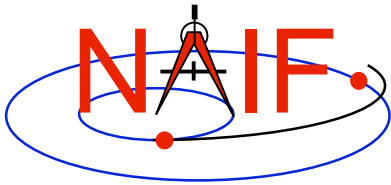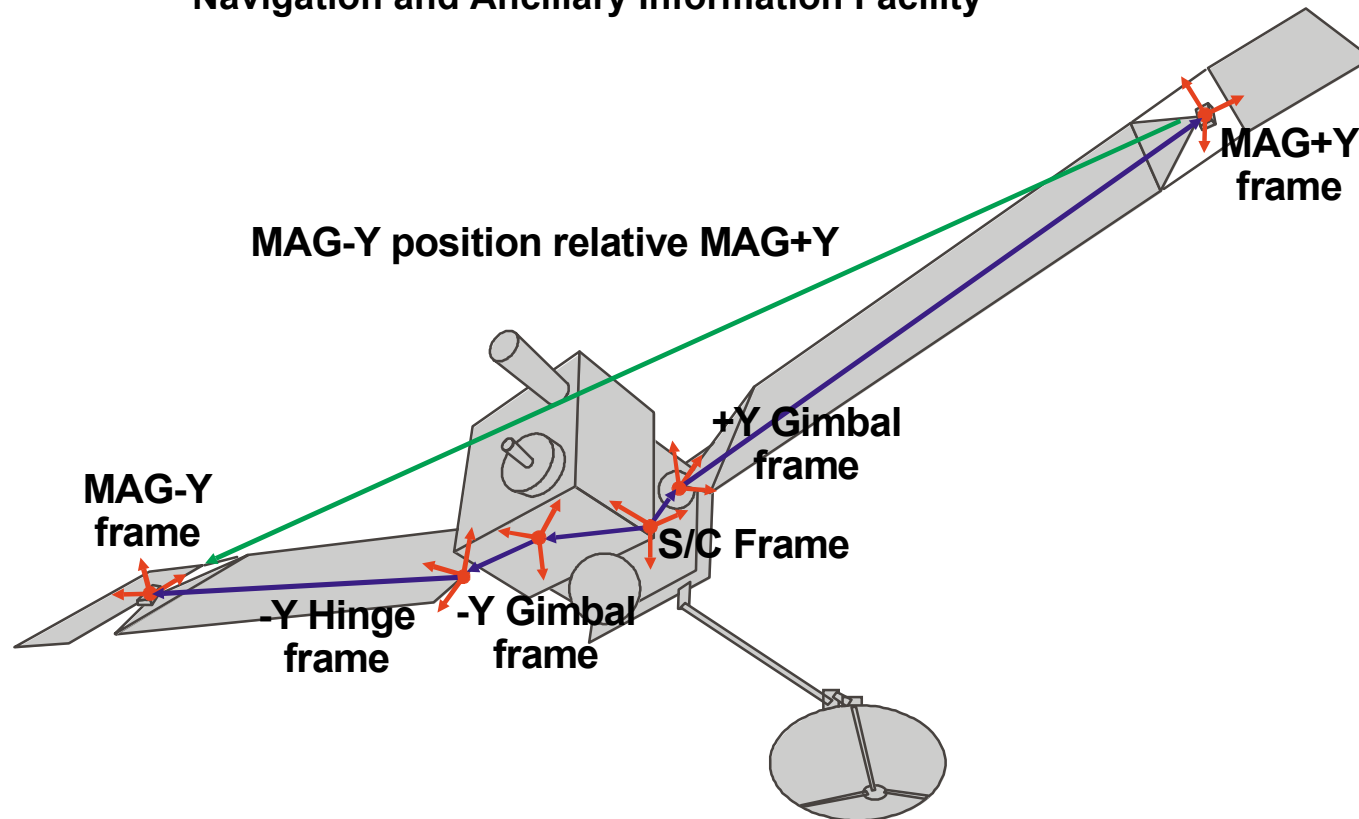
Angles at the Surface

Compute solar azimuth and elevation at the Huygens probe landing site

```
CALL SPKPOS('SUN',ET,'HUYGENS_LOCAL_LEVEL','LT+S','HUYGENS_PROBE',SUNVEC,LT)
CALL RECLAT(SUNVEC, R, AZIMUTH, ELEVATION)
ELEVATION = -ELEVATION
IF (AZIMUTH .LT. 0.D0) THEN
   AZIMUTH = AZIMUTH + TWOPI()
ENDIF
```
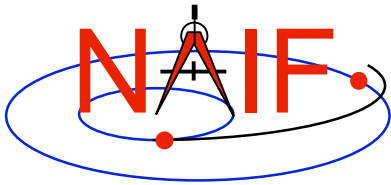
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MAG+Y
frame

MAG-Y position relative MAG+Y

+Y Gimbal
frame

MAG-Y
frame

S/C Frame

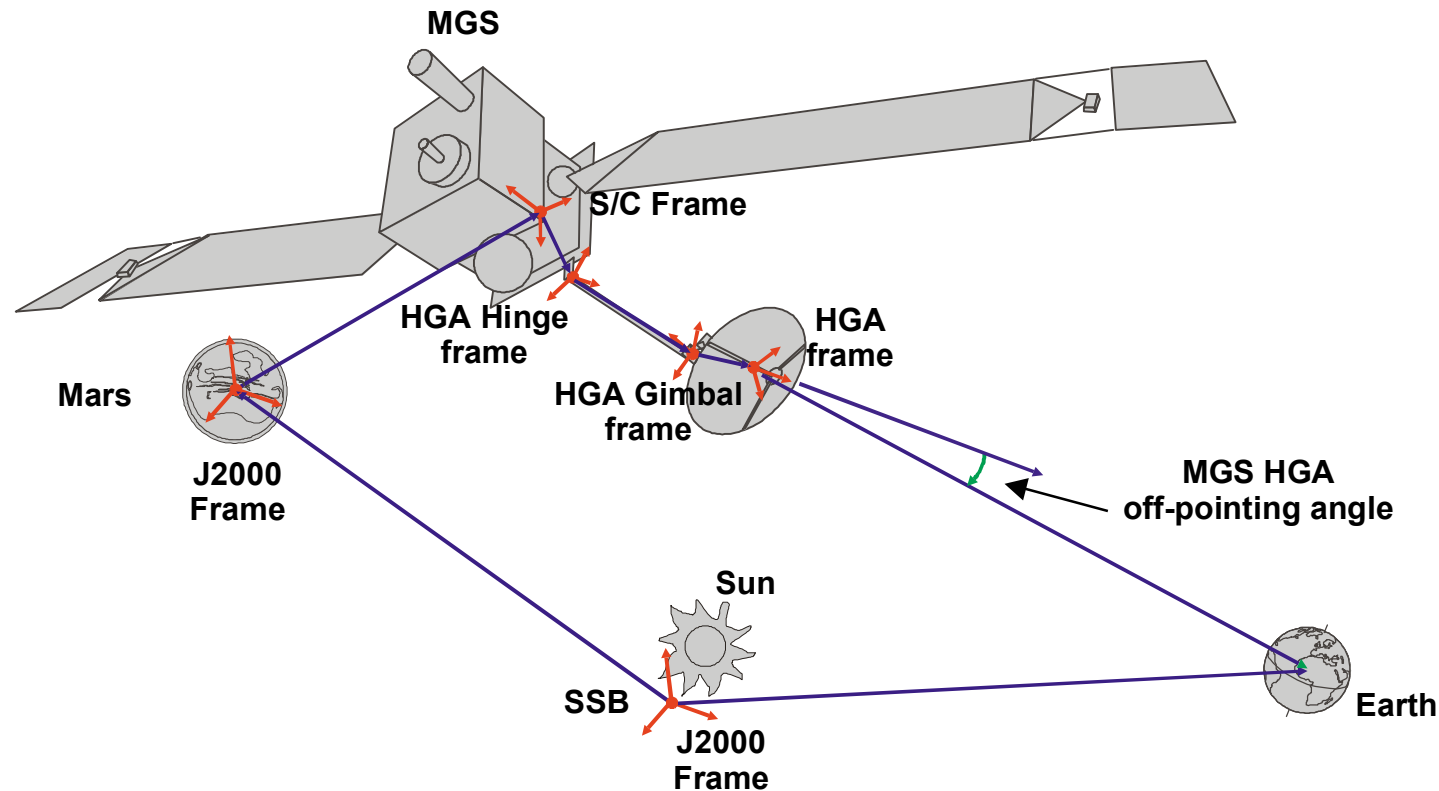-Y Hinge
frame

-Y Gimbal
frame

Find the position of one MGS MAG sensor with respect to the other in the MGS s/c frame. Also find the relative orientation of sensors:

```
CALL SPKEZR('MGS_MAG-Y', ET, 'MGS_SPACECRAFT', 'NONE', 'MGS_MAG+Y', STATE, LT)
CALL PXFORM('MGS_MAG_+Y_SENSOR', 'MGS_MAG_-Y_SENSOR', ET, MAT)
```
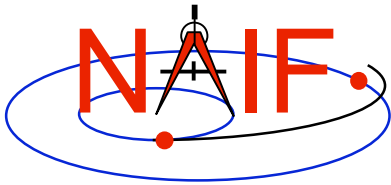
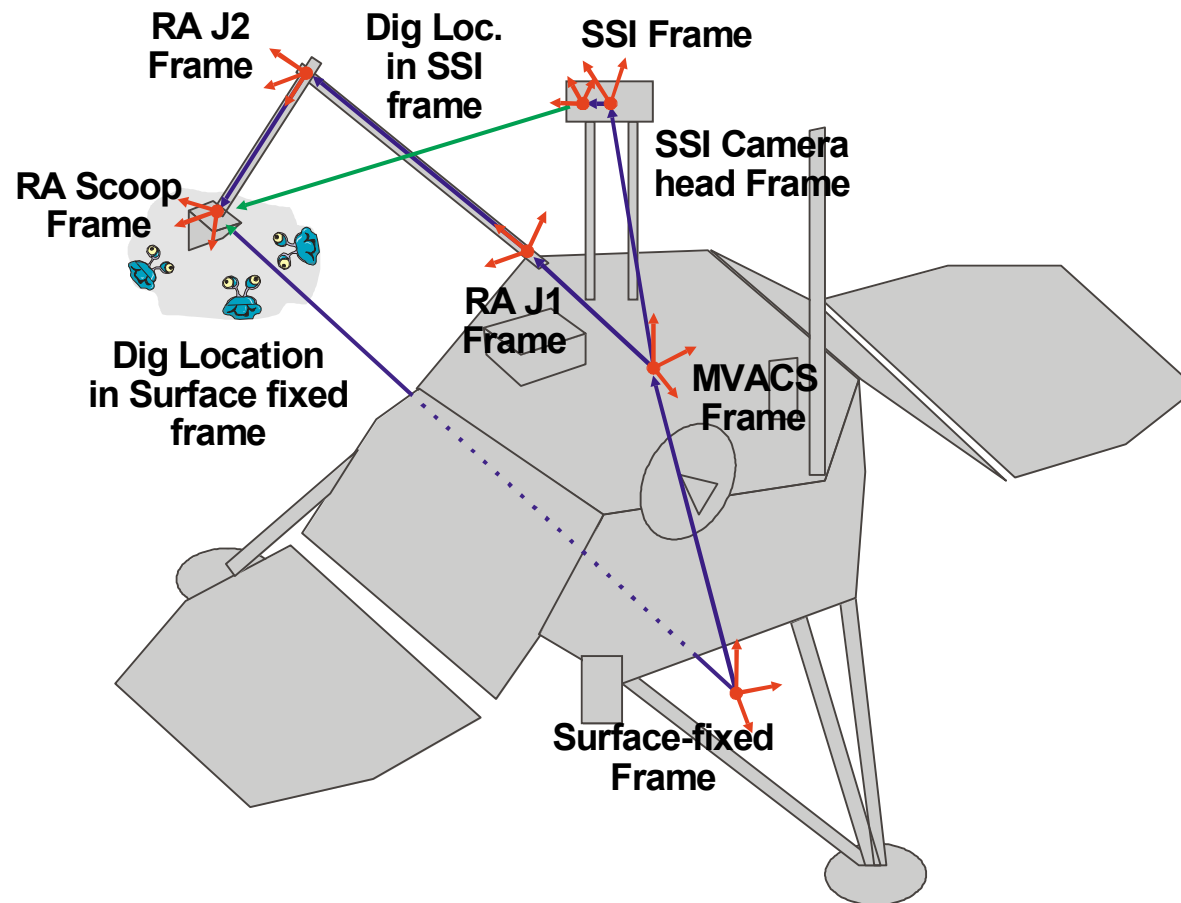**Navigation and Ancillary Information Facility**

Compute the angle between the direction to Earth and the MGS HGA boresight:

```
CALL SPKEZR( 'EARTH', ET, 'MGS_HGA', 'LT+S', 'MGS', EARTH_STATE, LT )
ANGLE = VSEP( HGA_BORESIGHT, EARTH_STATE )
```

Navigation and Ancillary Information Facility

Compute the dig location in MPL surface-fixed and camera left eye frames:

```
CALL SPKEZR( 'MPL_RA_SCOOP',ET,'MPL_SURFACE_FIXED','NONE','MPL_SURF',ST1,LT )
CALL SPKEZR( 'MPL_RA_SCOOP',ET,'MPL_SSI_LEFT',      'NONE','MPL_SSI', ST2,LT )
```